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Group Based Energy Efficient Scheduling in Wireless Sensor Networks

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Abstract :- Wireless Sensor Networks (WSNs) consist of small nodes with sensing, computation, and wireless communications capabilities. Many routing, power management, and data dissemination protocols have been specifically designed for WSNs where energy awareness is an essential design issue. In this paper, we present an energy efficient scheduling of nodes in wireless sensor networks. Scheduling is done among the nearby nodes because it's well known that the nodes lying in the vicinity of each other i.e. the nearby nodes whose inter distance is too much small will sense the same data from the field the nodes are deployed in. So scheduling is done among the nearby nodes so as to increase the lifetime of network by saving the energy used in transmitting the redundant data from the nearby nodes.

Keywords*— *WSNs, SN, LEACH, TEEN Grouping, PEGASIS

I. INTRODUCTION

A Wireless Sensor Network (WSN) contains hundreds or thousands of these sensor nodes. These sensors have the ability to communicate either among each other or directly to an external base-station (BS). A greater number of sensors allows for sensing over larger geographical regions with greater accuracy. Basically, each sensor node comprises sensing, processing, transmission, mobilizer, position finding system, and power units as shown in Fig1. Sensor nodes are usually scattered in a sensor field, which is an area where the sensor nodes are deployed. Sensor nodes coordinate among themselves to produce high-quality information about the physical environment. Each sensor node bases its decisions on its mission, the information it currently has, and its knowledge of its computing, communication, and energy.

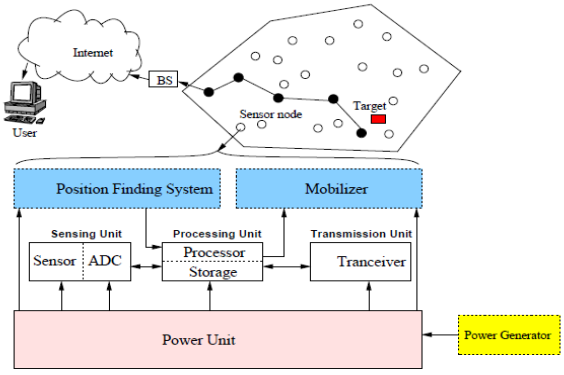

Figure 1: Basic Components of a Sensor Node.

resources. Each of these scattered sensor nodes has the capability to collect and route data either to other sensors or back to an external base station(s). A base-station may be a fixed node or a mobile node capable of connecting the sensor network to an existing communications infrastructure or to the Internet where a user can have access to the reported data.

the main design goal of routing protocols in WSNs, is on uniform load distribution among the SNs in order to increase the network lifetime. Many protocols existing in the literature minimize the energy consumption on routing paths[2-4], but they do not prolong network life time. even if dynamic routing is used to forward data with highest residual energy, it may cause unbounded delays and routing loops, hot spot etc.

in WSNs density of nodes brings in an inbuilt redundancy in the amount of data sensed by the overall network since the nearby nodes will sense almost the same data and send it over the network. This unnecessarily cause bandwidth wastage, congestion and dissipation of energy resulting in reduced overall network lifetime.

In this paper we proposes a scheduling mechanism among the nodes those exists in close proximity of each other and will sense similar data. The proposed scheme is implemented with a parameter called grouping diameter (G_d). This mechanism will allow group reformation. The group will act a single node for rest of the network while applying any of the routing protocol at the abstract level. Grouping factor is only at the lower level. In a single group there are number of nodes so if single node get depleted with time rest of the members of nodes will take over the charge and continue the data transmission from the same area for long time.

II. RELATED WORK

One of the main design goals of WSNs is to carry out data communication while trying to prolong the lifetime of the network and prevent connectivity degradation by employing aggressive energy management techniques [1]. Routing protocols in WSNs are classified in three classes[5]: Direct communication protocol, Flat routing

protocol and clustering protocol. first two are simple to implement and easy to extend but these are not able to do data aggregation as there is no management node in network, being homogeneous in nature.

LEACH[6] is a cluster based, distributed, autonomous protocol. Base station randomly chooses a portion of SNs as cluster heads and remaining nodes choose their nearest heads to join them, result in formation of cluster. Cluster's node send data to its CH then it forward it to base station.

TEEN[7] is similar to LEACH in its clustering mechanism. It sets two threshold values, a soft and a hard threshold, during data collecting stage, for reducing the traffic, reducing overall energy consumptions and increasing the network lifetime. Similar protocols are available but none of them is providing any mechanism to use the densely random deployment of nodes in the field. We are using this dense deployment of nodes i.e. proximity of nodes to each other in the deployment field, to form the group and then scheduling the nodes in each group so as to increase the network lifetime.

III. SYSTEM MODEL

we have assumed that the WSN formed is homogeneous and randomly deployed in fixed square region. Each SN of the network is configured evenly in terms of its energy, range, computation power etc. resulting in an homogeneous network formation.

- Each SN has a unique identity
- all SNs are stationary i.e. fixed after deployment
- physical location of nodes is unknown
- transmitter can adjust its amplifier power based on distance
- BS is unique and is located far away from network

since the nodes lying in a small diameter (G_d) called grouping parameter will sense almost the same data, so this will increase the redundant data over the network if all of the nodes are in active mode at the same time. Grouping provides an effective method to prolong the lifetime of network.

Grouping is done at the lower level only then at abstract level we will use LEACH for the transmission purpose. So our scheme consists of two phases:

1. Grouping Phase
2. Group Nodes Scheduling
3. Data Transmission

Our proposed model will work as follows:

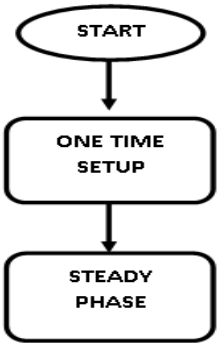

Figure 2: Proposed Protocol Life Cycle

IV. IMPLEMENTATION

The general energy consumption is given as:

$$E\_communication = 900 * Ecomputation$$

.....(1)

energy used in communication is much higher than that of used in computation work done by a SN. Moreover energy consumption is dependent on the distance over which a SN has to transmit. We use a model shown in [9] as:

$$E(l,d) = \begin{cases} lE_{elec} + l\varepsilon f_s d^2, d < d_0 \\ lE_{elec} + l\varepsilon m_p d^4, d > d_0 \end{cases}$$ .....

..(2)

the E_{elec} depends on factor such as digital coding, modulation, whereas the amplifier energy $\varepsilon f_s d^2, \varepsilon m_p d^4$ depends on transmission distance and acceptable bit-error rate.

The receiving node calculates its distance from source using the strength of received signal. This is done using free energy dissipation model :

$$P_r(d) = P_{tx} \times \frac{\varepsilon}{d^2}$$

.....(3)

Where P_r is the power of received signal, d is distance and ε is the attenuation coefficient.

Form (3) d can be calculated as: $d = \frac{r}{\sqrt{p_r}}$

Where, r is constant.

1. Grouping phase:

Grouping parameter we will use is G_d, is a distance measure, and for nodes to be a part of group must lie within this parameter value provided that G_d must be less than the range of SNs, as if it is not there then node becoming part of groups will not able to transfer the data to their next hop, so care must be taken off.

We deployed a random network of SNs as shown in figure 2.

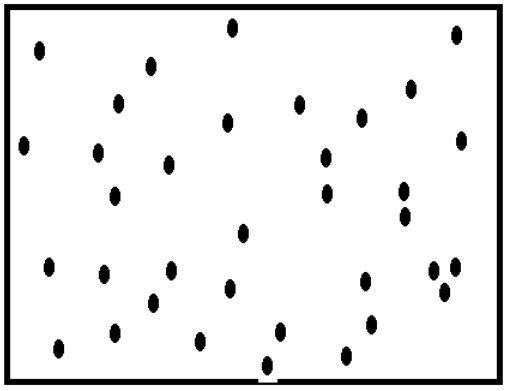

Figure 3: Randomly deployed Network

Network can be treated as a complete graph where each node is connected to all of the nodes. Let n1 n2 are two nodes of graph as SN, then these two nodes will be adjacent if:

$$d(n1,n2) \leq G_d$$ .....

...(4)

after the deployment of nodes in area, all nodes broadcast a HELLO message in the format as:

ID SOURCE

Figure 4: HELLO PACKET

such that the signal strength is sufficient to transmit the message to a distance B_d called broadcast distance, such that

$B_d = G_d + \mu$ .....(5)

where μ is very small distance beyond G_d so as to reach the packet safely

if $d \leq G_d$ then the receiving node will accept the packet else discard it. Receiving nodes will create a list of nodes from which they are accepting the packets, this list is called neighbourhood list (NL). so after this transmission each node will have its NL with it. Then every node will send the NLP to BS in format as shown:

ID SOURCE	NL

Figure 5: NLP PACKET

BS create a neighbours table (NT) based on the NLP packet received from each node. Now base station will direct the SNs to form groups as follow:

1. Depending on the NT, BS will create Group Packet as

ID SOURCE	NL

Figure 6: GROUP PACKET(GP)

2. GP is broadcasted over the network, every node on listening the GP will look for its own ID in member list (ML), if it found then it accept the packet and does not read any other packet else it

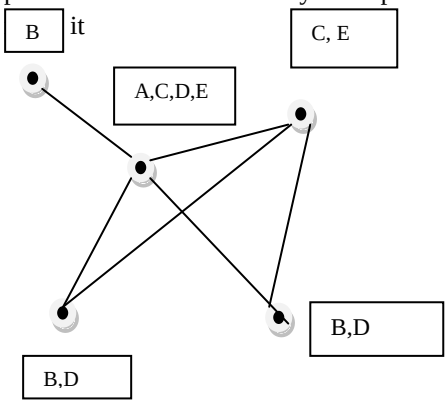

Figure 7: SNs with NL

After this the groups will be formed like shown below:

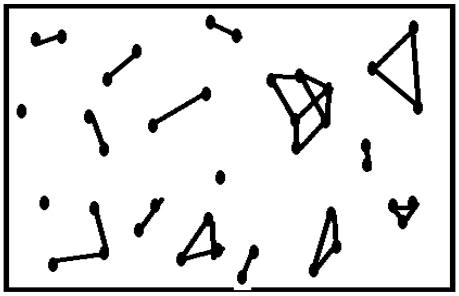

Figure 8: Uneven grouping of Nodes in WSN

2. Scheduling Phase:

Let T_{MAX} is the maximum time a node can transmit based on the energy available to it. E_{TH} is the threshold energy after which node will not be able to transmit.

Every group member on receiving GP will receive the node IDs in a particular sequence. This will determine the active & sleep pattern of nodes in a single group. The scheduling will take place as follow:

1. The first ID in GP will be first in active mode rest will go in sleep mode.
2. The switching will be done if:
   i. TIME $T \geq T_{MAX}$, where T_{MAX} is the maximum time given for switching i.e. maximum time for which a single node can transmit the data.
   ii. $E_{REMAINING} > E_{TH}$, It must transmit packets till it has energy to awake up next node in list one by one and broadcast a message to declare itself as dead.
   iii. All members receiving this broadcasted message will remove it from their list and node next satisfying (ii) will become active.

Scheduling can be shown as:

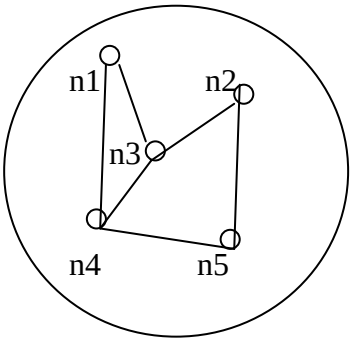

Figure 9: Group Scheduling

so now only one node will be active at a time and rest will be in sleep mode, so this scheme will increase the network life as nodes will not get depleted fast due to redundant and unnecessary data transmission , also the aggregation loads of management nodes at abstract level will get decreased so they have to consume less energy in data aggregation and have to transmit smaller data packets.

V. PERFORMANCE EVALUATIONS

As the degree of grouping increases i.e. number of nodes in close vicinity to each other the , energy consumption in data aggregation decreases. Communication energy will also decreases with more number of groups. So based on above results As network lifetime is inversely proportional to energy consumptions, so will increases correspondingly. The following are the simulation parameters assumed for our Scheme:

- distance between BS and network is taken as 150m
- Size of data packet is 200 bytes
- electronic power is 50nJ/bit
- free space attenuation coefficient is 8pJ/bit/m^2
- multipath attenuation coefficient is 0.0008pJ/bit/m^4
- node's initial energy is 10J
- E_{th}= 0.005J

Effects of group degree on network life time are as below:

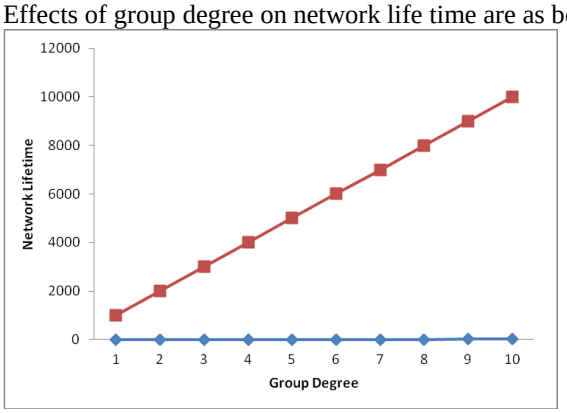

Figure 10: Effects on Network LifeTime

VI. CONCLUSION

As final conclusion, our grouping scheme at lower level will provide a basis for energy savings in implementation of any of available routing protocol like LEACH, TEEN, PEGASIS etc. Lower level groups will act as single nodes at abstract level, thereby increasing the node lifetime as number of nodes in the group will be available to get the data from same field for longer time because if one node get depleted then rest of the nodes of that group will take over the charge and continue until the all of nodes in a single group get depleted.

In future work can be done to make an uniform grouping as the group formation in the proposed scheme is uneven, there are scope to make it uniform that will result in more energy efficient routing schemes for WSNs.

REFERENCES

[1] Routing techniques in wireless sensor networks: a surveyjamal n. Al-karaki, the Hashemite university ahmed e. Kamal, iowa state university ieee wireless communications • december 2004.

[2] HO.Tan, "Power efficient data gathering and aggregation in wsns" SIGMOD record, 2003, 32(4): 66-71.

[3] Y.YANG, M.ZHOU, X.ZHANG, " overview of routing protocols in wireless sensor networks", journal of spftware, 2006, 17(3): 410-421.

[4] O.YOUNIS, S.Fahmy, " Distributed Clustering in Adhoc sensor networks: A Hybrid, energy- efficient approach", in Proceedings of the IEEE INFOCOM 2004, Hong Kong, IEEE Computer Press, 2004, pp: 630-640.

[5] WR.Heinzelman, J. Kulik, H. Balakrishnan, "Daptive protocols for information Dissemination in Wireless Sensor Networks", In proceedings of fifth annual international conference on mobile computing and Networking, Seattle: ACM Press, 2001, pp. 174-185.

[6] W. Heinzelman, A.Chandrakasan and H. Balakrishnan, " An Application-Specific protocol architecture for wireless microsensor networks", IEEE Transactions on Wireless Communication 1(4):660-670, 2005.

[7] A. Manjeshwar, DP. Grawal, "TEEN: A protocol for enhanced efficiency in wireless sensor networks", In proceedings of 15th Parallel and Distributed Processing Symposium, San Francisco, IEEE Computer Society, 2001, pp.2009-2015.

[8] H. Zhang and J. C. Hou. Maintaining sensing coverage and connectivity in large sensor networks. Intl. Journal of Wireless Adhoc and Sensor Networks,1(1-2):89 124, 2005.

[9] A. Krause, C. Guestrin, A. Gupta, and J. Kleinberg, " Near optimal sensor placements: Maximizing information while minimizing communication cost", in proceedings of Information Processing in Sensor Networks, 2006.

